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GREEN CLEANING: AN ESSENTIAL ASPECT OF MALAYSIAN GREEN BUILDINGS

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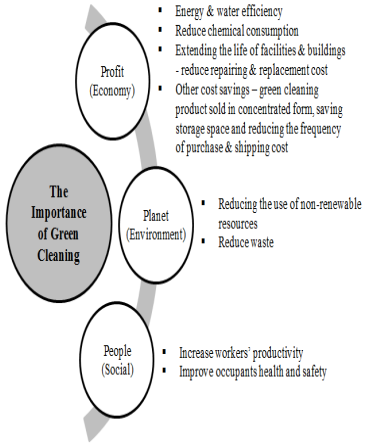
Graphical abstract



Abstract

This paper discusses the importance of green cleaning for green buildings during the operations and maintenance stage. The investment on green buildings is often driven by the aim to reduce energy consumption. However, many tend to overlook the importance of the operations and maintenance aspect of the building, particularly the green cleaning aspect. Green cleaning is a major contributor to Indoor Environmental Quality (IEQ) where IEQ is one of the important criteria that should be considered during the assessment of green building performance. In Malaysia, there is no specific regulation set for green cleaning. Green Building Index (GBI) tools itself does not specifically highlighting green cleaning in their assessment tool. Thus, based on literature review, this paper discusses the benefits of implementing green cleaning and how green cleaning can contribute to achieving better green building performance.

Keywords: Green building, operations and maintenance, green cleaning

Abstrak

Kertas ini membincangkan tentang kepentingan pembersihan hijau kepada bangunan hijau semasa peringkat operasi dan penyelenggaraan. Pelaburan terhadap bangunan hijau biasanya didorong oleh matlamat untuk mengurangkan penggunaan tenaga. Namun begitu, ramai cenderung untuk mengabaikan kepentingan aspek operasi dan penyelenggaraan dalam sesebuah bangunan terutamanya aspek pembersihan. Pembersihan Hijau adalah penyumbang utama kepada Kualiti Alam Sekitar Dalaman (IEQ) di mana IEQ adalah salah satu kriteria penting yang perlu dipertimbangkan semasa penilaian prestasi bangunan hijau. Di Malaysia, tidak ada peraturan khusus yang ditetapkan untuk pembersihan hijau. Pihak *Green Building Index* (GBI) sendiri tidak mengambilkira aspek pembersihan hijau dalam penilaian mereka. Oleh itu, berdasarkan kajian literatur, kertas ini membincangkan faedah melaksanakan pembersihan hijau dan bagaimana pembersihan hijau boleh menyumbang untuk mencapai prestasi bangunan hijau yang lebih baik.

Kata kunci: Bangunan hijau, operasi dan penyelenggaraan, pembersihan hijau

1.0 INTRODUCTION

Sustainable development is not a something new and its concept is very popular among practitioners in construction industry. It was introduced to improve a quality of life for current people and future generation [1]. The most commonly used definition of sustainable development comes from The Brundtland Commission, where sustainable development is defined as "the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs" [2]. In Malaysia, the Government introduced green building as an attempt to achieve the goals of sustainable development. Green building has an important role in achieving the aim of sustainable development [3] which is to protect environment and to improve the quality of human life.

2.0 GREEN BUILDING

Most of green building definitions incorporate environment, economy and social aspect. Green building can be defined as the way structures are designed, constructed and maintained in order to decrease energy and water consumption and costs, improve the efficiency and sustainability of the building systems and reduce the negative impact buildings impose on the environment and public health [4]. It also can be defined as a way of enhancing the environment, which benefits human well-being, community, and environmental health and life cycle costs [5].

The environment, economy and social aspects are actually belonging to the concept of sustainable development [6]. Green buildings is not only about design the building to be green, but it must be operated and maintained with the safety, health, comfort and with an understanding of the next generation's need to reuse and recycle building components [7].

Green buildings use key resources like energy, water, materials, and land much more efficiently than conventional buildings. It create healthier work, learning, and living environments, with more natural light and cleaner air, and contribute to improved employee or student health, comfort, and productivity. They are cost-effective, saving taxpayer dollars by reducing operations and maintenance costs, as well as by lowering utility bills [8]. Apart from economic benefits, social and environmental benefits of green buildings need to be revealed in order to persuade developers and clients to risk new approaches and use the new sustainable technologies [9]. The following are the benefits of green building in terms of economy, environment and social aspects:

i. **Economic benefits**: Many researchers emphasise the economic aspects of green building. They believe that green buildings can provide direct and indirect economic benefits. The economic benefits can be seen through the operating expenses such as costs for energy, water, maintenance, repair etc. As mentioned earlier, green buildings are cost-effective in which they normally have lower operating expenses [8, 10]. The green technology installed in the buildings are able to reduce energy and water usage costs; reduce maintenance costs by adopting specific materials and systems that simplify and reduce the maintenance requirements and processes; and extend building lifetimes[7]. In addition, green building will increase the satisfaction level of occupants in terms of facilities and the building itself. Complaints related to flaw, damage and any deficiency in a building can be minimised and this will eventually reduce the expenses for dealing with complaints [12]. This also will improve the ability to attract new employees and increases asset value [12].

ii. **Social benefits**: The improvements in the quality of life and well-being of people and society are among the benefits that can be achieved through the development of green buildings. These include health, comfort, and satisfaction [9]. Through green design, the negative impacts of building environment such as illness, absenteeism, fatigue, discomfort, stress, and distractions are expected to reduce which can improve occupants' health and performance of buildings. For example, indoor air quality or IAQ (which is part of the requirements that should be considered in green building) and personal control over systems (i.e. lighting and temperature) have strong positive effects especially in terms of productivity [11] and it is seen as a major influence on occupant's comfort [45]. Several studies also have mentioned that good IAQ will reduce health problems (e.g. allergic, asthma etc.), and improve occupants' productivity and lead to significant savings in health care costs [45, 46].

iii. **Environmental benefits:** In the construction industry, the scarcity of natural resources is not a new phenomenon. Hence, the green building was introduced as one of the strategies to reduce the use of natural resources especially non-renewable resources (e.g. energy, metallic etc.). Green design can significantly reduce the impact of building construction on the environment.

Buildings, which produce 25% of the solid waste, 24% water usage, 20% of the water effluents and occupy 15% of land, will increase the level of environmental pollution due to energy and natural gas consumption and these activities carry an implicit "ecological footprint" of resource consumption and waste generation [12]. Thus, applying green design principles can significantly reduce these impacts.

3.0 GREEN BUILDING OPERATIONS AND MAINTENANCE

No matter how green a building may have been in its design, it can only remain so if it is operated responsibly and maintained properly [7]. Operations and maintenance is a continuous activity in every types of building to ensure the building is maintained and operated in a good way. Just like conventional building, green building requires maintenance to ensure that building and facilities are in good condition. There is the need for sustainable or green maintenance for green building. Sustainable maintenance can be defined as a maintenance system that meets the value system of the present users without compromising the ability of meeting the value system of the future users [13]. Maintenance constantly affects the **quality of environment** by reducing waste, pollutant and other resources; **affects financial performance** by reducing energy and water consumption and costs; and **affects people's** comfort, health, safety and productivity [13, 14, 15, 16].

Compared to conventional building, green buildings are expected to reduce energy consumption, reduce resources use and render economic benefits in operational cost even though the upfront costs are higher [9]. Unfortunately, some of green buildings are not performing as what they are supposed to especially in terms of energy consumption. Green buildings use high energy than expected [17, 18, 19, 20, 21, 22]. This problems lead to high energy cost and directly influence the operations and maintenance cost.

The operations and maintenance issues are usually attributed by design deficiencies and the complexity of technologies in green buildings [17, 23, 24]. The construction industry nowadays tends to focus too much on glamorous new construction and still leaving the maintenance aspect of the design and construction process [25]. Studies on green building operations and maintenance are very few in comparison to the abundant studies on green design and construction [25]. Most green buildings may have a good green design but how about their operations and maintenance?

Green buildings focus on increasing the efficiency of energy, water and materials used; and to reduce the overall impact it has on human health and the environment throughout its lifecycle [26]. "Throughout its lifecycle" means that the facilities and buildings must be intended to be a green building right from the design stage until its removal. But, how the management or maintenance teams want to operate and maintain the buildings in a green way when there is unclear operations and maintenance guideline [27, 28, 29] for green buildings in Malaysia?

Though numerous literatures and studies on green building are available, there is still a gap of how green building are managed, maintained and operated. There are many types of maintenance services during operations and maintenance stage of a building and this involves cleaning. Cleaning can be classified as a top important building maintenance services during operations and maintenance stage compared to other building maintenance services such as air-conditioning; sanitary/plumbing; mechanical and electrical; lighting etc. [30]. Cleaning represents a major part of facilities management expenditure [31]. Thus, it is imperative to study about cleaning aspect of green building.

4.0 GREEN CLEANING

Clean is a condition free of unwanted matter that has the potential to cause an adverse or undesirable effect while cleaning is the fundamental management process of putting unwanted matter in its proper place to achieve a clean condition [32].

The first thing that people will concern in green building is about reducing energy consumption. Many tend to overlook the maintenance aspect of the building, namely cleaning [33]. Reducing energy will not make those buildings "green" if they still using highly toxic of cleaning products [34]. Most of the conventional cleaning products contain high level of volatile organic compound (VOCs) that lead to variety of health issues and problems to the building occupants and cleaning personnel [35]. The products and processes of conventional cleaning may also contribute to indoor pollution [36, 37] and this will make building occupants feel uncomfortable, distracted, and sick and reduces their motivation to work. When occupants feel uncomfortable with the building's environment and health issues arise, these will lead to increasing healthcare and insurance costs [38].

Green cleaning can be defined as cleaning to protect health without harming the environment, using procedures and products to ensure cleaning is conducted for the health of building occupants, janitors and the environment [34]. It aims to reduce the use of chemicals, water and energy. The goals of green cleaning is to minimize environmental and human-health impacts, while maintaining or even improving the effectiveness of cleaning programs [39]. Green cleaning is related to the concept of sustainability [34, 38, 39, 40]. Adopting green cleaning will have a positive impact on the economy, society and environment.

Green buildings need green cleaning. However, in Malaysia, there is no specific standard or regulations set for green cleaning even though there are those who suggest that Malaysian government need to highlight green cleaning in their policies as well as its enforcement [33]. There is also no requirement specifically highlighting green cleaning in the GBI rating tool (the GBI rating tool is Malaysia's industry recognized green rating tool for buildings to promote sustainability in the built environment). GBI just generally mentioned about using environmental friendly product whereas green cleaning is not just limited to using environmental friendly products but also includes all janitorial activities, processes, procedures, training and initiatives designed to protect the health of occupants without harming the environment [33]. Therefore, it is important to understand the concept of green cleaning and its contribution to the sustainable development.

5.0 THE IMPORTANCE OF GREEN CLEANING IMPLEMENTATION FOR SUSTAINABLE DEVELOPMENT

Green cleaning has a direct impact on the sustainability of a building. It will effectively balancing the organisational profits in terms of economic; its benefits for community and society; and the environmental impact of the organization's activities [40].

5.1 Profit (Economic)

A comprehensive green cleaning program should have a positive economic impact which means drives down the cost to clean such as reduction of energy, water and chemical consumption and cost; and reduce maintenance cost.

Day Shift cleaning is one of the strategies of green cleaning. Previously, night time cleaning has been the norm especially in commercial buildings. However, increases in operating costs such as energy costs (due to excessive use of lights, elevators and HVAC from day until night) and higher medical expenses (due to higher rates of injury and illness) causing the transition from the night shift to the day shift. This strategy has the potential to reduce operating costs as the lights and other energy-based equipment are off at night [34, 43]. It will reduce the energy costs up to 10% by adopting this program [44]. With adequate training, cleaners will focus on lighter duty during working hour such as emptying waste baskets and cleaning restrooms. For heavier tasks such as vacuums and floor scrubbers; or in high-traffic areas, cleaning can be done in the early morning or evening which is before and after building occupants arrive [34, 43, 44].

Cleaning can still be done with less water and cleaning products. By using appropriate and suitable cleaning equipment, we can reduce 20-30% of water usage [38]. For instance, new floor scrubber cuts water usage by up to 70% compared to conventional floor scrubbers as the new floor scrubbers use ultra-low-flow dispensing which allows the janitor to control and choose where to apply extra water or detergent [39]. When fewer detergent, water and energy are used, this will reduce the impact of cleaning on the environment. Then, by minimising resource consumption will contribute to extending the life of facilities and buildings and this will reduce the cost of repairing or replacement in long term [39].

Meanwhile, the cleaning products are usually sold in concentrated form. It seems trivial but very helpful in achieving cost savings by saving storage space used for cleaning products and reducing the frequency of purchase and shipping cost [34].

5.2 Planet (Environment)

The cleaning industry impacts the environment in a number of other ways as well. The author has mentioned the economic benefits of green cleaning i.e. operations costs reduction due to reduction of energy consumption, water and cleaning product usage. The reduction of energy, water and chemical consumption will directly reduce their impact to the environment and one way to save our planet.

However, before adopting green cleaning, we have to understand how conventional cleaning directly affects the environment:

i. Misuse and overuse of cleaning chemicals are very common due to untrained cleaning personnel [40].
ii. Most of cleaning products are still made from scarce, non-renewable resources [40].
iii. The manufacturing and bleaching processes have enormous environmental and health impacts [40].
iv. Poorly designed cleaning equipment (e.g. vacuum cleaners, floor scrubbers etc.) may cause worker injuries. The equipment usually designed for limited time use, consume tremendous amounts of resources which in turn leads to landfills every year [40].

Hence, it is important to implement green cleaning practices in green building because it will reduce the impact of cleaning on the environment by reducing the use of non-renewable resources. Green cleaning materials and equipment are believed to be more efficient in long term [41]. In green cleaning programme, cleaning personnel should be trained to estimate the use of cleaning products; how to efficiently use and manage the products, materials and equipment; and carry out the cleaning process effectively according to standard prescribed.

5.3 People (Social)

It is imperative to consider the impact of cleaning products and equipment on the well-being of building occupants prior to their selection. Conventional

cleaning products and equipment can impose various health and environmental concerns. Most cleaners who experience long-term exposure to cleaning chemicals, suffer several health issues, that may include eye and skin burns, respiratory irritation, asthma, reproductive and developmental problems, etc. Problems associated with skeletal health among cleaners are also attributed to poorly-design cleaning equipment. The use of poorly designed systems and equipment, and the requirements to lift heavy objects, can also cause chronic musculoskeletal problems [40, 42].

Improved indoor environment may increase worker productivity by 5 to 7% [38]. Studies have shown that improved cleaning practices reduce absenteeism by more than 11% and illness by up to 30%. Green cleaning reduces toxins in the workplace and safeguards both janitorial workers and building occupants [34].

Figure 1 summarizes the importance of green cleaning implementation for sustainable development i.e. profit (economy); planet (environment); and people (social).

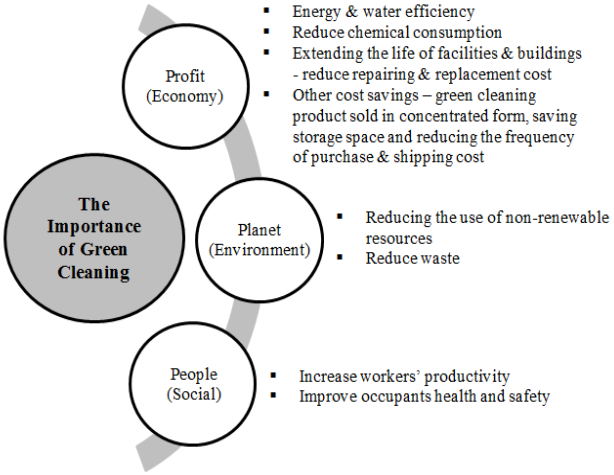


Figure 1 The importance of green cleaning implementation for sustainable development

6.0 CONCLUSION

This paper has discussed the importance of green cleaning implementation in green buildings during the operations and maintenance stage. Green cleaning needs to be implemented as a standard practice in green building operations and maintenance. Various researchers and related parties have acknowledged the significance of green cleaning in achieving green building goals and this directly influence the principles of sustainable development namely environment, economic and social. However, in Malaysia, green buildings are limited to reducing energy consumption. There is no specific standard or regulations set for green cleaning. The GBI rating tool does not specifically highlight green cleaning requirements. Thus, it is imperative to study about green cleaning that encompasses the requirement and processes that should be included in green cleaning, who should be involved, how it is to be implemented etc.

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